## VII. Notes on the Wing Veins of Insects. By J. O. WESTWOOD, Esq., F.L.S.

[Read June 2, 1856.]

It cannot but have been observed by persons who have taken the trouble to watch the progress of Entomological science during the past quarter of a century, that there has grown up a very constant practice, where difficulties of a physiological kind have arisen with reference to the structures or uses of particular organs of the insect world, of assuming that we are in the necessary inability to determine the question, because the general construction of these tribes of animals is so very different from that of ourselves and other vertebrated tribes. This kind of reasoning appears to me, however, in many cases to be only a plea for ignorance, carelessness of investigation or sluggishness of mind in reasoning upon the facts which our own researches, or those of previous authors, have re-That insects have no orifices in the head which we can vealed. assign definitely to those of the ears or nose of the higher animals, is no reason why insects should not hear or smell; but that with elaborately furnished mouths and digestive apparatus, delicate instruments of touch, wonderfully-constructed eyes, most powerful muscles, and a singular system of circulation, we should affirm that we cannot understand the physiology of the senses of taste, touch and sight, or the processes of motion or circulation, appears to me to be unworthy of the advanced state of physiological science in the present day. A paper entitled a "Memorandum on the Wing Rays of Insects," by Mr. Newman, has been recently published in our Transactions, Vol. III. N. S. p. 225, so full of what appears to me to be false deductions, and in which the differences between exosteate and endosteate animals is so strongly insisted upon, that I must take leave to trouble the Society with a few notes on the subject. After remarking upon the necessity of some one rising to take up the mantle of George Newport, and upon the great assistance which the nervures, veins, ribs, rays or bones of the wings of insects afford in enabling us to distinguish species, genera, and even families from each other, Mr. Newman believes he is correct in saying that we make no attempt to ascertain their use, or to learn

## Wing Veins of Insects.

the allotted part which they play in the economy of the animal, the definite function which these organs are specially created to perform; and then he mentions a series of celebrated authors who have not attempted to work out conclusions which they have left to be inferred from the names which they have given to the various parts in question. But in this list he singularly omits the names of those great modern physiologists who have actually treated upon this question, including even George Newport himself, whose remarks, subsequently to be cited, it is evident that he can never have read. In like manner, at the same time he completely ignores the peritracheal controversy which has attracted so much attention lately on the continent. The following passages, from the works of Owen, Burmeister and Newport, will prove distinctly that circulation takes place in the wings of insects through these nervures, veins, or whatever else they have been termed.

Professor Owen, in his lectures on the invertebrate animals, observes, "The strong and numerous nervures which sustain the thin alary membranes of the *Libellula* are articulated processes of the external chitinous tegument. A circulation can be traced through these membranes, at least in their early and softer state; air vessels are abundantly spread over the supporting frame work.

"The wings of insects are essentially flattened vesicles sustained by slender but firm hollow tubes called nervures, along which branches of the tracheæ and channels of the circulation are continued.

"The chief merit of the re-discovery of the circulation of blood in insects is due to Carus, its phenomena having been witnessed in the appendages of insects by other observers, as Ehrenberg, Wagner, Burmeister, Bowerbank and Tyrrell."

Professor Burmeister (Man. of Entomology, translated, p. 96) observes, that "in outward appearance the wings present themselves as flexible but dry membranes, which are traversed by various horny ribs. These ribs, or more properly VEINS, as they are in fact vessels, but incorrectly called nerves, arise all from the roots of the wing." And again (p. 407), "In all perfect insects of the order *Dictyotoptera* (*Neuroptera*), namely, in the wings of just disclosed *Libellulæ* (*L. depressa*) and *Ephemeræ* (*E. lutea* and marginata), Carus saw a distinct motion of the blood. *Hemerobius chry*sops, Semblis bilineata and S. viridis exhibited in their wings (and the latter also in their antennæ) a motion of the juices. In the former Carus saw the streaming blood pass upon the anterior margin through the chief ribs and distribute itself upon the whole margin to the apex; it returned back through the ribs, lying nearest to the posterior margin. Through the central connecting transverse ribs blood also passed from the proceeding to the returning current." Burmeister then enters into lengthy details, both structural and physiological, the result of which is that although the ribs, as the translator calls them, contain tracheæ, or air vessels, the latter are enclosed within a vacant space, in which the juices can freely circulate (p. 412).

Newport, again (article "Insecta," in Cyclop. Anat. and Physiology, p. 112), after stating the observations of Carus, Burmeister, Tyrrell, Wagner, and especially Bowerbank, in the Entomol. Magazine, vol. 1, p. 243, as well as observations of his own, proceeds, "From these facts we are led to express an opinion, which has been long entertained by us, that the course of the blood, whether simply along intercellular spaces, or bounded by distinct vessels, is almost invariably in immediate connexion with the course of the tracheæ. This opinion is founded upon the circumstance that nearly all the observations that have hitherto been made have shown that the currents of blood in the body of an insect are often in the vicinity of the great tracheal vessels, both in their longitudinal and transverse direction across the segments, and it is further strengthened by Mr. Bowerbank's observations on the course of the blood in the wing." After detailing these observations, he concludes, "These observations are exceedingly interesting in reference to the general velocity of the circulation, and the means by which it is carried on in the wing. The entire absence of pulsations is remarkable, as it completely identifies these vessels as VEINS, since it is well known that the circulation is carried on through the body by means of regular pulsations of the dorsal vessel.

Such are the considerations which induced me, in my portion of the "Genera of Diurnal *Lepidoptera*," to employ the term vein for these organs, and to assert that physiological investigations had proved them to be such.

But Mr. Newman (after demolishing a phantom of his own creation, in the shape of a nerve hypothesis, every writer who had employed the term nervure having expressly guarded himself from the implication of an inferred identity between the functions of true nerves and these nervures, the latter of which names cannot be considered as a dimunitive of the former, but has always been used and intended as a distinct term), and after also citing my observations in the "Genera of Diurnal Lepidoptera," hesitates to accept the premises, because he denies that a single observation has ever been made that can warrant such a conclusion. I can only account for such a denial on the supposition that Mr. Newman had not taken the trouble to consult the leading authorities on the subject.

But Mr. Newman further rejects the vein theory, because the organs in question form a strong durable frame work supporting a filmy membrane, like the paper on the frame of a kite, and because certain profoundly-devised experiments of his own, such as cutting the leading bars or rays of the frame across, and removing the membrane itself from the frame-work, have taught him (what every child who ever sent up a kite into the air would have told him was self-evident), that the structure would not support the object in the air if the frame of the kite were sent up without paper, or if the chief bars of the frame were broken. Unquestionably, then, Mr. Newman's assertion, that these organs are instruments of support, is correct; in fact, it has never been disputed, but on the contrary affirmed by all writers; but it does not thence follow that the organs in question are not veins. An electric wire is not less an electric wire because it is enveloped in a gutta percha tube, and used as an electric telegraph wire. In the construction of the wings of insects two objects were necessary, a system of support and a system of circulation which required defence, and we see in the arrangement of these organs one of the most admirable contrivances of a divine and omniscient Creator which can be pointed out in the many marvellous peculiarities of the insect frame.

Having, however, arrived at the conclusion that the rays of an insect's wing perform precisely the same functions as the bones of a bat's wing, and that the wing of a butterfly is the exact analogue of the wing of a bat, Mr. Newman seems to have been alarmed at the result, and instead of employing for these organs the name of any of the bones of the vertebrata (one of which, rib, or rippe, has been long used for them by German Entomologists), he rejects Dr. Leach's term, pterygostea or wing-bones, and thinks "that the simple word ray, Latinized by radius, will be found sufficiently descriptive, and fortunately possesses another claim, that of priority."

I readily admit that if we knew nothing of the functions of these organs, it would be very advisable to apply to them a name which implies no known function, just as it is still advisable to retain the name antennæ in preference to that of feelers or ears, but with positive physiological facts before us, I maintain that we are fully justified in giving to these organs the name of veins.

## 64 Mr. J. O. Westwood on the Wing Veins of Insects.

I have only to add that the final remark of Mr. Newman quoted above is a fallacy. The term radius has not the priority over that of nervures, or veins, for the organs in question. Jurine, who first proposed the term radius, employed that of nervures for the organs in question. "Ayant étudié les ailes des hyménoptères et des diptères, j'ai remarqué que leurs nervures formaient un réseau cellulaire, &c." (N. Méth. class Hym., p. 2); and after describing the two strong parallel *nervures* at the anterior margin of the wing, he says, "Ces deux nervures n'ayant pas encore reçu de nom, j'ai jugé qu'il était nécessaire de leur en donner un :---en conséquence j'ai donné celui de radius à la nervure externe et celui de cubitus à l'interne" (*Ibid.* p. 3).

P.S. Since these notes were written a remarkable memoir by A. H. Haliday, Esq., on the same subject, and in which the vein theory is also maintained, has appeared in the Dublin Natural History Review.

VIII. A Revision of the British Atomariæ; with Observations on the Genus. By T. VERNON WOLLASTON, Esq. M.A., F.L.S.

## [Read 5th January, 1857.]

HAVING paid some little attention, during the last few years, to our native Atomariæ, I propose, in the following paper, to lay before the Society an enumeration of the species which have been hitherto ascertained to inhabit the British Isles. The confusion which has unfortunately arisen through the inaccurate identifications of the late Mr. Stephens, whose collection (now in the British Museum) must moreover be regarded as the sole interpreter of his very meagre and unsatisfactory diagnoses, has rendered the task a somewhat tedious one; nevertheless, a careful collation of his entire series (amounting, however, to only 111 specimens in all), in conjunction with the assistance which I have derived from the material which various friends (amongst whom Messrs. Waterhouse, Janson, Douglas, Murray and Morris Young, should be particularly mentioned) have placed in my